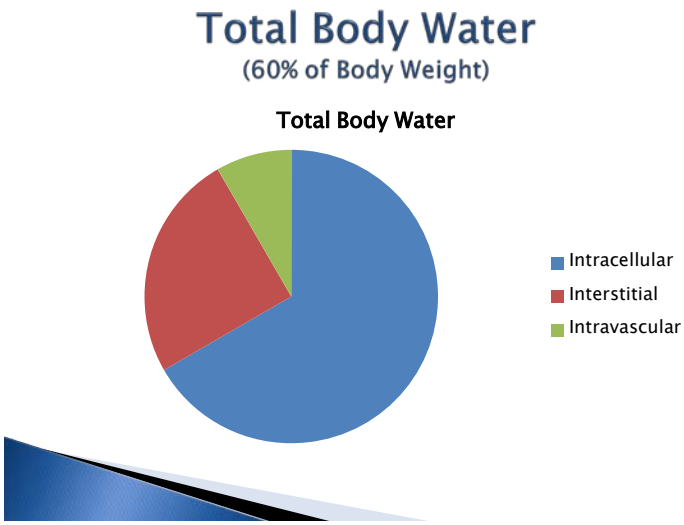
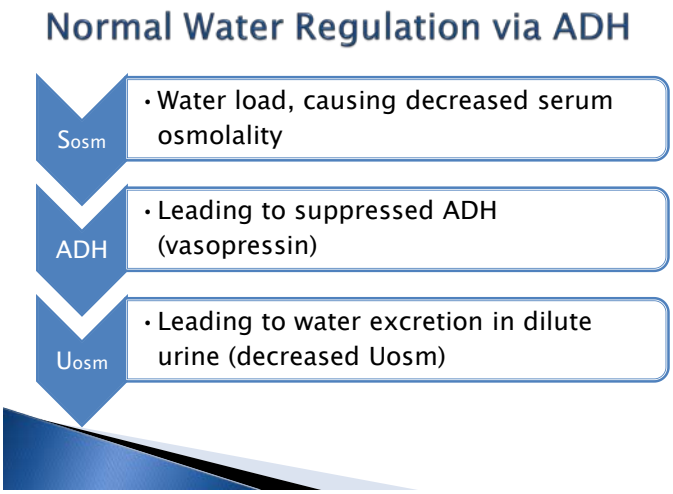
UPDATED
Diagnosis and Management of Hyponatremia

Melinda Johnson, MD, FHM, FACP, FPHM
Associate Professor, Internal Medicine
University of Iowa Hospitals and Clinics

Hyponatremia

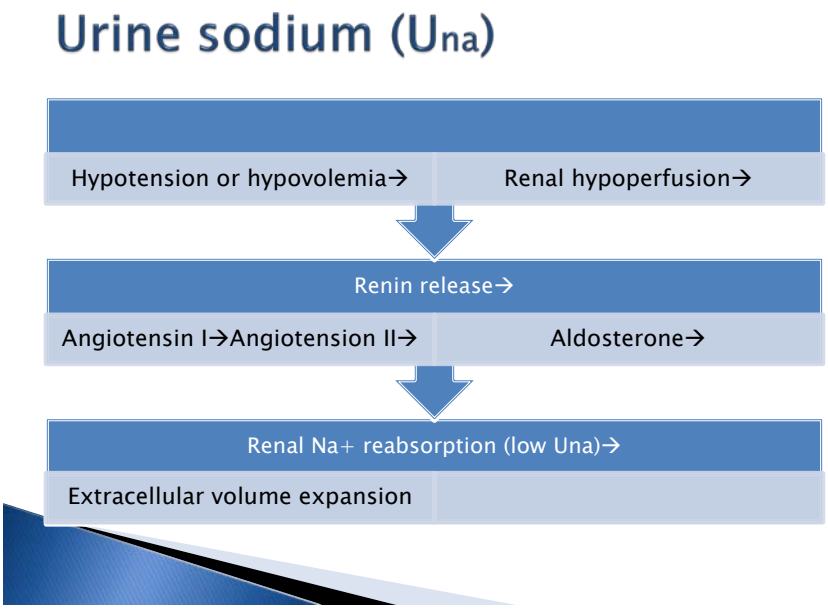
- Serum sodium concentration <135 mEq/L
- Severe hyponatremia <120 mEq/L
- Disorder of water, not salt
- Occurs in ~15% of all hospital inpatients
- Increased morbidity and mortality
- Symptoms depend on rate of fall





Impaired Renal Water Excretion

1. Inability to suppress ADH
    - True hypovolemia: low Sosm, low arterial blood volume
    - Effective arterial blood volume depletion: cirrhosis, CHF
    - Endogenous stimuli: nausea, pain
    - Thiazide diuretics: reabsorb water, less NaCl reabsorption in distal tubule
    - SIADH
2. Suppressed ADH but overwhelmed excretory capacity of kidney
    - Advanced renal failure
    - Primary polydipsia
    - Beer potomania



When should I worry a lot?

1. Symptoms:
    - Headache
    - Muscle cramps
    - Reversible ataxia
    - Psychosis
    - Lethargy
    - Apathy
    - Agitation
    - Seizures
    - (Coma, respiratory arrest, death)
    - Duration:
        - Last sodium level
        - If it's not broke, don't fix it quickly
    - Clinical history:
        - Adrenal crisis (hypotension, weakness, shock)
        - Hypothyroidism/ myxedema coma (altered mental status, hypothermia, bradycardia, hypotension)
        - Cerebral salt-wasting syndrome (head injury, intracranial surgery, subarachnoid hemorrhage, stroke, brain tumor)
        - Marathon runner

Evaluation of Hyponatremia

- History
    - Urgent indication
    - Fluid loss
    - Free water intake

- Medications
- Other medical problems
- Small cell carcinoma
- CNS disease

- Physical Exam:
  - Volume status
  - Pulmonary
  - Neurologic
  - Stigmata of chronic illness
- Labs:
  - Serum osmolality
    - Compared to calculated
    - Sosm = 2(Na) + glu/18 + BUN/28
    - Difference should be less than 20, or unmeasured osmols present
  - Urine sodium: marker of intravascular volume status and ability of kidney to reabsorb Na
    - <20 mEq/L = low effective circulating volume
    - >20 mEq/L = no hypovolemia and/or renal salt-wasting
  - Urine osmolality: marker of ADH level
    - <100 mOsm/kg = suppressed ADH
    - >300 mOsm/kg = inability to suppress ADH

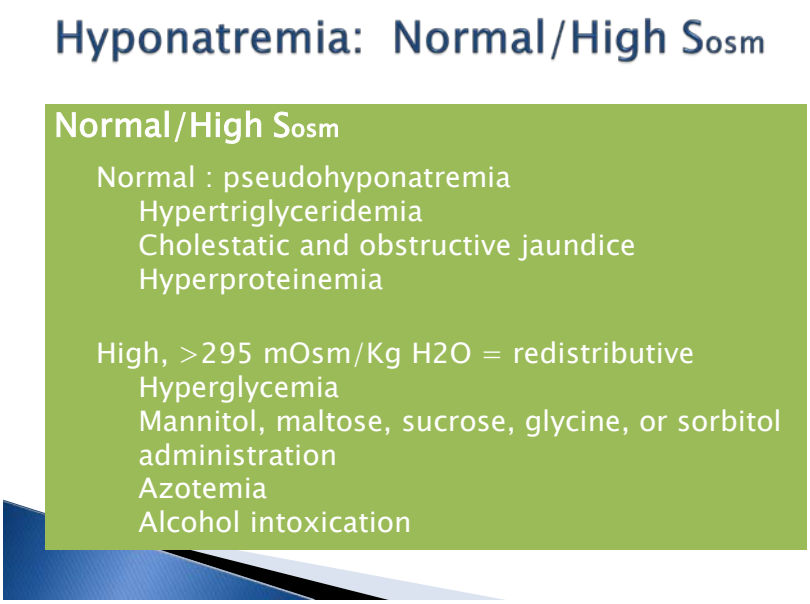
Before You Can Call it SIADH
You Must Find:

- Low serum osmolality
- High urine sodium
- High urine osmolality (high ADH)
- Normal creatinine
- Normal acid-base and K
- Normal adrenal and thyroid function

SIADH

- CNS process
- Lung process
- Cancer
- Medications
  - SSRI's
  - Desmopressin
  - NSAID's
  - Tricyclics
  - Nicotine
  - Other
- Idiopathic

Hyponatremia Treatment:
Normal or high serum osmolality



- Correct underlying problem
  - Lipids, multiple myeloma, bilirubin
  - Hyperglycemia
    - Need to correct if indirect potentiometry
    - Add 1.6-2.4 mmol/L to Na for every 100 mg/dL glu above 100 mg/dL
  - Remove other solutes, toxins
  - Dialysis

Hyponatremia Treatment:
Low Sosm:

Hyponatremia: Low Sosm

Hypovolemic	Hypovolemic	Euvolemic Una >20	Euvolemic Una >20	Hypervolemic	Hypervolemic
Una<20 mEq/L	Una >20 mEq/L	Uosm <100 mOsm/kg	Uosm >300 mOsm/kg	Una<20 mEq/L	Una >20 mEq/L
1. Dehydration	1. Drug effect (thiazides, ACE-I)	1. Psychogenic polydipsia	1. SIADH	Uosm >300 mOsm/kg	Uosm <100 mOsm/kg
2. Diarrhea	2. Salt-wasting nephropathies	2. Beer potomania	2. Postoperative	1. CHF	1. Advanced renal failure
3. Vomiting	3. Mineralocorticoid deficiency		3. Hypothyroidism	2. Liver disease	
	4. Cerebral sodium-wasting		4. Drug effect (thiazides, ACEI)	3. Nephrotic syndrome	
			5. Endurance exercise		
			6. Glucocorticoid deficiency		

General Principles

- If it's not broke, don't fix it quickly
- Treat if acute
- Treat if symptomatic
- If not acute or symptomatic, consider etiology and trending
- Actual correction often exceeds what is intended
- If replacing potassium, likely will raise serum sodium level
- Go slow and check often
- Do not exceed 1-2 mEq/L/hour or 12 mEq/L in 24 hours
- 4-6 mEq/L increase in serum sodium level enough to reverse most severe manifestations of acute hyponatremia

Central Pontine Myelinolysis

- Osmotic demyelination syndrome

- Hyponatremia corrected too rapidly
- Mental status changes, seizures, horizontal gaze paralysis, spastic quadriplegia
- Do not exceed 1-2 mEq/L/hour or 12 mEq/L in 24 hours
- Risk increased if Na<121, alcoholism, liver disease, malnutrition, severe hypokalemia, goal 4-6 mEq/L per 24 hours, do not exceed 9 mEq/L in 24 hours

Low Sosm: Hypovolemia

- 1. **Hypovolemia:**
  - Isotonic saline (Na 154 mEq/L)
    - Corrects hyponatremia a little
    - Removes stimulus for ADH release
  - Fix underlying reasons

Low Sosm: Euvolemia

- 2. **Euvolemia:** SIADH, psychogenic polydipsia, beer potomania, endocrine, medication
  - Fluid restriction to below level of urine output, usually <800 mL/day
  - Urine to serum electrolyte ratio (Una + Uk)/Sna
  - Hyponatremia likely to improve with fluid restriction alone if <0.5
  - Fluid restriction alone may be insufficient if >1
  - Loop diuretic +/- oral salt tablets in SIADH if urine to serum electrolyte ratio >1
  - Isotonic saline likely to worsen hyponatremia

Low Sosm: Hypervolemia

- **3. Hypervolemia with effective circulating volume depletion: heart failure, cirrhosis, nephrotic syndrome**
  - Fluid restriction to below level of urine output, usually < 800 mL/day
  - If very concentrated urine (>500 mOsm/kg), fluid restriction alone may be insufficient
  - May require diuresis with loop diuretic
  - Advanced renal failure (renal failure with hypervolemia and Una>20) may require hemodialysis for hypervolemia

Hypertonic Saline: Emergencies Only

- 100 mL of 3% (hypertonic) saline bolus, **only** in patients with **severe symptoms**
- May repeat 1-2 more times at 10 min intervals
- ER or ICU setting

While Treating in Inpatient Setting

- Monitor electrolyte levels every:
  - 2 hr minimum if giving saline
  - If fluid restriction alone, depends on change
- Monitor serum osmolality, urine sodium, and urine osmolality as needed to evaluate for:
  - Suppression of ADH release and renin release after fluid resuscitation in true hypovolemia
  - Response to diuretics in CHF, cirrhosis

Summary

- Diagnosis of hyponatremia: History, Physical, SosmUnaUosm
- Treatment of hyponatremia:
    - Normal/high serum osmolality
        - Treat underlying etiology
    - Low serum osmolality
        - Hypovolemia: isotonic saline
        - Euvolemia: fluid restrict + correct underlying etiology
        - Hypervolemia: fluid restrict
- Monitor closely
- Do not exceed 1-2 mEq/L/hour or 12 mEq/L in 24 hours (or max 9 mEq/L in 24 hr in high risk patients)
- 4-6 mEq/L improvement to reverse severe manifestations

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